

IAU SYMPOSIUM 240

BINARY STARS AS CRITICAL TOOLS & TESTS IN CONTEMPORARY ASTROPHYSICS

Prague, Czech Republic

22-25 August 2006

preliminary program

as of 27 January 2006

DAY 1, SESSIONS 1/2

Welcome and Introductory address: Setting the stage

- ★ Prospects for combining classical and newly-emerging techniques and modelling approaches
- ★ Areas where binaries are useful tools for deriving important physical properties
- ★ Binaries as test benches to study specific and unique astrophysical problems.

Speakers: P. Harmanec (Czech Rep.) & E. Guinan (USA) [*5+25 min.*],

I. New Observing Techniques and Reduction Methods

A. Observing with high angular and spectral resolution

1. Multiple-aperture interferometry: results from visible and IR arrays (CHARA, NPOI, VLTI, SUSI, GI2T, ISI, Keck, etc.)
 - a. Overview of results from the Northern hemisphere
Invited Speaker: H. McAlister (USA) [*40 min.*]
 - b. Overview of results from the Southern hemisphere
Invited Speaker: J. Davis (Australia) [*20 min.*]
2. Interferometry with single telescopes: visible and IR speckle interferometry, adaptive optics, HST FGS, other single-aperture techniques) [*30 min.*]
3. High-precision radial-velocity measurements: Accuracies are now better than 10 m/s — sufficient for extrasolar planet searches, etc. [*30 min.*]

Poster presentations [*30 min.*]

DAY 1, SESSIONS 3/4

B. New possibilities for standard observational techniques

1. Eclipsing Binaries: prospects from spectroscopy and photometry with large telescopes
 - a. A general overview
Invited Speaker: I. Ribas (Spain) [30 min.]
 - b. Eclipsing binaries in Local Group galaxies
Invited Speaker: A. Bonanos (USA) [30 min.]
2. Classical observations of visual binary and multiple systems
 - a. Visual pairs: data from standard techniques, surveys (UCAC, Sloan, etc.), contributions from amateurs
Invited Speaker: B. Mason (USA) [40 min.]
 - b. Toward a common language — the Washington Multiplicity Catalog:
The blurring of traditional distinctions between “wide” and “close” binaries has resulted in a confusion of rules for naming binary and multiple stars and their components. The WMC is an effort to create a common nomenclature scheme for all types of companions.
Speaker: W. Hartkopf (USA) [20 min.]

C. Improved methods of data analysis

1. Techniques for decomposition of blended spectra: cross correlation, spectral disentangling in direct and Fourier transformed images, minimization algorithms, broadening functions, modelling the Rossiter effect, detecting photometric variations from spectroscopy
Invited Speakers: H. Hensberge (Belgium) & K. Pavlovski (Croatia) [40 min.]

Poster presentations [20 min.]

DAY 2, SESSIONS 5/6

C. Improved methods of data analysis (continued)

2. Bipolar Jets, Hot Interaction Regions, and Colliding Winds in OB Interacting Binaries
Invited Speaker: G. Peters (USA) [15 min.]
3. Studying magnetic activity in cataclysmic binaries using high resolution near-IR spectroscopy
Invited Speaker: S. Kafta (Chile) [15 min.]
4. Doppler tomography of accretion disks of close binaries (CVs and Algols) [30 min.]
5. Doppler imaging and eclipse maps of spotted stars [30 min.]
6. Reducing data from long-baseline interferometers: Processing long-baseline interferometry data presents a unique set of complications: How does one derive relative astrometry when one or both components is resolved? How can 1-D interferometric results be used to solve a 2-D orbit? How can baseline-only solutions be combined with historical data and how should older baseline data be published so that they can be combined with later interferometric data?
Invited Speaker: Ch. Hummel (Chile) [30 min.]
7. Crossing the barriers: Simultaneous solutions of spectroscopy, photometry, astrometry and polarimetry: Can the combination of high-precision photometry, radial velocities, and astrometry help to improve the accuracy of stellar masses, radii, distances, luminosities, etc.? These collaborative efforts are needed as valuable checks on stellar structure and evolution theories.
Invited Speaker: R. Wilson (USA) [30 min.]

Poster presentations [30 min.]

DAY 2, SESSIONS 7/8

D. Observing in the Era of Large-Scale Surveys

1. Large-scale automatic searches: Advantages and shortcomings photometric programs (MACHO, OGLE, ASAS 3, DIRECT, MOA, etc.); satellite observations (ROSAT, etc.); use of variability-induced motion and other colour-based detection methods to search Sloan and potentially other databases (Gaia, SIM, etc.) for new binaries

Invited Speaker: D. Pourbaix (Belgium) [40 min.]

2. Pipeline reduction of binary light curves from large-scale surveys

Invited Speakers: A. Prsa (Slovenia) & T. Zwitter (Slovenia) [40 min.]

3. Reduction of eclipsing binary data in the Magellanic Clouds

Invited Speaker: T. Mazeh (Israel) [10 min.]

The remainder of this session will include one or two additional talks and an expanded period of discussion and poster presentations. Possible topics for posters and talks include (but are by no means limited to): [100 min.]

- * Potentials of new astrometric/photometric/spectroscopic missions and telescopes (SIM, Gaia, TPF, COROT, KEPLER, MOST, etc.). In the near future data are expected to arrive for millions of interacting and eclipsing binaries discovered from ultra-wide-field photometric surveys (e.g., OGLE and OGLE II, MACHO, DIRECT). There are now light curves for several thousand eclipsing binaries in the Bulge and in the Magellanic Clouds. This number will balloon to several 100K and up to several million from ASAS, ROTSE, and STARE. Millions are expected from the Large Synoptic Survey Telescope (LSST), while GAIA will deliver some 8 million EBs (of which about 100,000 will have radial velocities, calibrated colours, and distances).
- * Mining Terabyte datasets — how will a finite number of astronomers deal with an exponentially increasing quantity of data? Note that from the thousands of EBs discovered so far from the OGLE and MACHO programs, fewer than 30 have been fully analyzed! Given the future availability of millions of EB light curves, we have to find ways to dramatically improve this yield! Powerful tools and techniques from the field of Artificial Intelligence may offer a realizable means to deal with these problems and get a trend line that scales with the data. One solution may be the development of an Intelligent Data Pipeline with an Astrophysics Expert Module to be used to automatically analyze and extract important astrophysical information from these data.
- * Can amateurs play a role in exploiting the expected bounty of new data?
- * What is the role of the Virtual Observatory — how will it impact the field of double stars?
- * What are the dangers in flooding the wide community with open access data? It is already very easy to access large numbers of observations from an ever-growing number of databases. Additionally, easy-to-use public software is plentiful. The combination of these two has resulted in a flow of papers whose results are, in many cases, useless. One might say this is the problem for the journal editors. On the other hand, this sort of use of these databases is not the aim of those who put the data on-line. How can the “owners” of these databases help?

DAY 3, SESSIONS 9/10

II. Binary Stars as Critical Tools for obtaining direct and reliable information

A. The need to improve basic calibrations

1. Critical comparison of Hipparcos and earlier trigonometric parallaxes with those derived from astrometry, interferometry + spectroscopy, etc.

Invited Speaker: W. van Altena (USA) [30 min.]

2. Addressing the problem of two dimensions for rotating stars: properties of stars of the same mass in eclipsing vs. spectroscopic, astrometrically-resolved systems, etc.; the need for a 2-D substitution for empirical scales of effective temperatures and BC corrections, based on energy distributions over the largest possible range of the electromagnetic spectrum

Invited Speaker: J. Aufdenberg (USA) [30 min.]

B. Increasing possibilities of classical methods: a few examples

1. Apsidal-motion tests of internal stellar structure from eccentric EBs, discrepancies possibly related to third bodies; reflection effects in brown-dwarf/star and giant-planet/star systems

Invited Speaker: A. Gimenez (Spain) [30 min.]

2. Binaries at the very low end of the mass range: overview of recent findings, detection techniques and the quantity and quality of information which they can yield, precision needed in mass, etc. to put some useful constraints on theories of their formation and evolution

a. The bottom of the Mass-Luminosity Diagram: M/L/T dwarfs [30 min.]

b. Recent Developments in Extrasolar Planet Systems: star + planet = binary, too! [30 min.]

Poster presentations [30 min.]

DAY 3, SESSIONS 11/12

B. Increasing possibilities of classical methods (continued)

3. Fragile binaries

- a. as observational leverage on “difficult objects”: For example, spectra of white dwarfs provide little information about their intrinsic radial velocity, space motion, population membership, metallicity, etc. Non-WD companions provide the benchmark that identifies the underlying property of the WD companion. Pairs which contain a WD also allow the calibration of chromospheric activity with age, via the WD cooling age.

Invited Speaker: T. Oswalt (USA) [20 min.]

- b. Common-proper motion pairs, moving groups, etc. and their relation to classical close pairs (EBs, SBs, etc.): Are they the tail of the same orbital separation distribution or do they have different origins? [20 min.]

C. Evolutionary models for binary and multiple stars

1. Progress in the theories of binary formation: theoretical simulations, impact of mass exchange on the chemistry of Galaxy, observational insights into binary star formation from statistics — distributions of a or P , M_2/M_1 , e in various contexts and how these change as star populations age [30 min.]

2. Progress in the theories of binary evolution

- a. New results from models in more dimensions

Invited Speakers: P. Eggleton (USA) & L. Kisseleva (UK) [30 min.]

- b. Testing and improving the dynamical theory of mass exchange:

Can mass loss and angular momentum loss from a system be modelled in a more realistic way? Theory of accretion disks, lessons for galactic disks; are there also outflowing disks and how can one decide? Streams and jets, 3-D gas-dynamical modelling, effects of circumstellar matter on observed light curves

Invited Speaker: D. Bisikalo (Russia) [40 min.]

3. Young binaries as a test for pre-Main Sequence evolutionary tracks [20 min.]

III. Binary Stars as Critical Tests for studying specific phenomena

A. Binary stars as probes of our Galaxy:

1. Wide binaries as probes of the Galaxy’s dynamical history

- a. The role of wide binaries and moving clusters as probes of the dynamical and merger history of our galaxy

Invited Speaker: C. Allen (Mexico) [20 min.]

- a. The distribution of separations of close and wide binaries as a probe of star formation and early dynamical evolution

Invited Speaker: A. Poveda (Mexico) [20 min.]

2. Close binaries as probes of the Galaxy’s chemical history **Invited Speaker:** D. Vanbeveren (Belgium) [30 min.]

Poster presentations [20 min.]

DAY 4, SESSIONS 13/14

B. Prospects of asteroseismology from pulsating stars in binaries:

Long systematic series of observations may provide a great chance to directly confront derived physical properties with those deduced from the pattern of stellar pulsations. By coordination of spectral, photometric and interferometric programs, information on core overshooting can be gained and confronted with that derived from a comparison of evolutionary models and directly derived properties of EBs

Invited Speaker: C. Aerts (Belgium) [30 min.]

C. The influence of binarity on stellar activity:

Active stars in close binaries often show starspots at preferred longitudes with respect to their companion stars. The emergence of flux tubes from the deeper layers of the active star is affected by tidal effects that break the rotational symmetry. Model calculations can be tested by observational results for different active stars (mass, rotation rate, age).

Invited Speaker: K. Olah (Hungary) [30 min.]

Poster presentations [30 min.]

*** Summary talk #1 (observational aspects?)**

Invited Speaker: C. Scarfe (Canada) [20 min.]

*** Summary talk #2 (theoretical aspects?)**

Invited Speaker: V. Trimble (USA) [20 min.]

*** Closing comments and thanks** [10 min.]